DISPATCH SYSTEM FOR CONTAINERS OF SORTED MAIL AND METHOD THEREFOR

Description

This invention relates generally to automated sorting and dispatching of mail which is sorted into containers, such as letter trays or tubs, and dispatched to manual carts. In particular, the present invention is directed to a dispatch system for receiving random trays or tubs, each containing sorted letters, and dispatching the containers to particular carts for forwarding to local post offices.

The dispatch operation in an automated mail processing and distribution center has traditionally been a labor-intensive operation. Unsorted mail enters the processing and distribution center and is sorted by automated sorting equipment into individual trays and tubs which must then be dispatched to a cart known as an Eastern Regional Mail Container (ERMC) which is a wheeled container with two fixed and two swivel casters. The trays or tubs contain a bar code in order to identify its destination and may be in either an uncovered condition covered with a sleeve or sleeved and banded.

Efforts have been made to reduce the manual labor associated with the dispatching of the letter trays or tubs. However, such efforts have been met with limited success. One attempt at a dispatch system 1, illustrated in Fig. 1, includes a gantry robot 2 which retrieves letter trays from an accumulation conveyor 3 and places each tray in a particular cart 4. Because the dispatch of each tray is by a robot, there is a commensurate reduction in manual labor. However, the throughput for dispatch system 1 is still not satisfactory. The reason is that the robot is capable of moving only a single tray or tub at a time to a cart. Additionally, safety regulations require that when a cart is full and in need of manual removal from the dispatch system, and replaced with an empty cart, it is necessary to mechanically lock out the robot 2 in order to prevent injury. Therefore, each time a cart is full, it is necessary to shut down the entire

dispatch system which further reduces the throughput of the system. While it may be possible to adapt dispatch system 1 such that gantry robot 2 could be merely locked out of operation in the area of the cart being removed rather than completely locked out, such selective lock-out for replacement of carts would be complicated and expensive to accomplish.

Another prior art dispatch system 5 utilizes a pedestal robot 6 which rotates in order to pick up trays from discharge conveyor 8 (Fig. 2) and places them into cart 7. Dispatch system 5 suffers from many of the same limitations as dispatch system 1 . When a cart 7 is full, it is necessary to lock out robot 6 while the personnel changes out any of cart 7.

In addition to the limitations set forth above, prior known dispatch systems are limited to handling only mail trays which are sleeved prior to the dispatching operation. This results in a lack of flexibility further restricting usefulness of the prior art systems.

Therefore, the object of the present invention is to provide a dispatch system and a method therefor which significantly increase throughput. It would additionally be desirable to provide a dispatch system which is capable of handling both trays and tubs of various sizes as well as containers which are uncovered, sleeved, or covered with cardboard. All of this should preferably be accomplished in a system which minimizes vertical height because installations often take place in older facilities which have limited ceiling heights. Any such dispatch system must comply with all pertinent safety requirements.

A solution for this object is given by the dispatch system for randomly arranged containers of sorted mail as described in claim 1 and by the method as claimed by claim 23. Preferred embodiments of the invention are provided by the claims 2 to 25 and 27 to 30.

A high throughput dispatch system, according to an aspect of the invention which dispatches randomly arranged containers of sorted mail to particular dispatch carts,

includes a sortation conveyor having a main line defined by a conveying surface, a plurality of spurs extending from the main line, and a diverter mechanism at each of the spurs. The diverter mechanism selectively diverts containers from the conveying surface onto one of the associated spurs. A postal dispatch system, according to this aspect of the invention, further includes at least one transport mechanism which transports containers from each of the spurs to a container juxtaposed with the spur.

The present invention is based upon a recognition that system throughput can be significantly increased by separating the sortation function from the cart-loading function. By separating these functions, it is possible to have a larger number of transport mechanisms, which, when operating in combination, can significantly increase throughput. The greater number of transport mechanisms increases throughput while the system is in full operation. Furthermore, because only the transport mechanism associated with a particular cart needs to be mechanically locked out of operation while that particular cart is being replaced with an empty cart, it is not necessary to lock out the entire system in order to replace a full cart with an empty cart. Thus, system throughput is further enhanced.

A container dispatch system, according to another aspect of the invention, includes a sortation conveyor as previously set forth and a transport mechanism associated with each of the spurs. The transport mechanism transports containers from the spur to a subjacent cart and includes an extendable support member and vertical lift. The extendable support member is adapted to retrieving containers from the spur and inserting the containers to the associated cart. The vertical lift is adapted to moving the support member between the vertical level of the spur and the vertical level of the cart. The extendable support member is figured in order to advantageously be able to handle more than one size of container. This allows the transport mechanism to transport trays and tubs of various dimensions. Advantageously, the extendable support member engages the underside of the container which allows the system to handle both covered and uncovered containers.

A method of dispatching randomly ordered containers of sorted mail to carts, according to another aspect of the invention, includes sorting containers to particular locations, each location associated with a cart and transporting containers between each of such particular locations and the associated cart.

These and other objects, advantages and features of this invention will become apparent upon review of the following specification in conjunction with the drawings.

Fig. 1 is a top plan view of a prior art dispatch system;

Fig. 2 is the same view as Fig. 1 of another prior art dispatch system;

Fig. 3 is a top plan view of a high throughput dispatch system, according to the invention;

Fig. 4 is an enlarged view of the area illustrated in phantom and designated IV in Fig. 3;

Fig. 5 is a dispatch subsystem;

Fig. 6 is a sectional view taken along the lines VI-VI in Fig. 5;

Fig. 7 is a side elevation taken along the lines VII-VII in Fig. 5;

Fig. 8 is a rear elevation of a transport mechanism;

Fig. 9 is a side elevation of the transport mechanism in Fig. 8;

Fig. 10 is a side elevation of an extendable support member of a transport mechanism;

Fig. 11 is a top plan view of the support member in Fig. 10;

Fig. 12 is a side elevation illustrating safety caging around a transport mechanism;

Fig. 13 is a top plan view illustrating safety caging around several adjacent transport mechanisms;

Fig. 14 is a rear end side elevation of a cart loaded with a particular type of tray;

Fig. 15 is a rear end side elevation of a cart loaded with a particular type of tub;

Figs. 16a-d are perspective views of various containers which can be dispatched with the dispatch system;

Figs. 17a-c are rear elevations of sortation spurs used with different types of containers; and

Fig. 18 is a top plan view of an alternative embodiment of the invention.

Referring now specifically to the drawings, and the illustrative ernbodiments depicted therein, a high throughput dispatch system 20 as illustrated in Fig. 3 may include a plurality of dispatch subsystems 22. The number of subsystems may be selected according to the particular application. In the illustrated embodiment, mail is sorted onto trays using conventional sorting equipment (not shown) and delivered to a merge area 24, shown in phantom, which feeds a sortation subsystem 26, also shown in phantom, which diverts individual trays of sorted mail to each dispatch subsystem 22 as well as to one or more optional manual dispatch areas 28, also shown in phantom. As will be explained in more detail below, the dispatch system 20 automatically dispatches the trays of sorted letters to conventional ERMC or similar USPS rolling stock.

In the illustrated application, the letter trays may be sleeved and banded or unsleeved prior to dispatching. Accordingly, as illustrated in Fig. 4, the take off lines of the sortation subsystem 26 lead to manual predispatching operations illustrated in phantom at 30. It is to be understood that in other applications such predispatching operations may not be provided. From the predispatching operation 30, an input conveyor 32, which, in the illustrated embodiment, is made up of an incline belt conveyor 34a, a turn conveyor 34b, an incline belt conveyor 34c, and a "no read" discharge chute 34d, intersects with a sortation line 36. Either scanner 38a or 38b reads bar codes (not shown) on the sides of mail containers, and, if a successful read occurs, a diverter 40 diverts the container onto sortation line 36. If a successful read does not occur, the container continues to chute 34d.

Once on sortation line 36, the container travels past a series of diverters 42 (Fig. 5). Each diverter 42 is adapted to diverting containers laterally off the conveying surface of sortation line 36 onto a spur 44. In the illustrated embodiment, a pair of spurs 44 are positioned on opposite sides of sortation line 36 in which case, diverter 42 is a bidirectional diverter. It should be understood that, in other applications, the spurs may be arranged on a single side of sortation line 36, in which case diverter 42 is a unidirectional diverter. In the illustrated embodiment, the conveying surface of sortation

line 36 is made up of a multiplicity of generally parallel powered rollers. Diverter 40 and 42 is a powered pop-up diverter. The powered roller conveyor is preferably a line-shaft conveyor of the type commercially available from Mannesmann Dematic Rapistan Corp., although other powered roller conveyors or other powered conveying surfaces may be utilized. Although in the illustrated embodiment diverters 40, 42 are pop-up belt driven diverters, other diverters, such as wheel diverters, positive displacement diverters, pushers, and the like, may be utilized. In the illustrated embodiment, sortation line 36 is in the form of a closed circuit. This configuration provides for recirculation of containers which are unable to be diverted upon their first pass for whatever reason. In such configuration sortation line 36 includes semicircular end sections 46 which are made from belt turn conveyors of the type manufactured by Mannesmann Dematic Rapistan Corp. It should be understood that sortation line 36 could, alternatively, be oriented in a straight line or any other geometric layout suitable to the application.

Each dispatch subsystem 22 includes one or more transport mechanisms 50. Each transport mechanism 50 transports containers from one of the spurs 44 to a cart 52 positioned subjacent to the associated spur (Figs. 6 and 7). Each transport mechanism 50 includes an extendable support member 54 (Fig. 7) which retrieves containers from the associated spur and which inserts the containers into the associated cart 52. Transport mechanism 50 additionally includes a vertical lift 56 which moves support member 44 between the vertical level of the associated spur 44 and the vertical level of the associated cart 52. Vertical lift 56 includes a pair of vertically oriented beams 58 and a trolley 60 which is supported for traveling along the length of beams 58 (Figs. 8 and 9). A plurality of spaced apart sheaves 62 rotatably supports a belt 64 whose ends 66 are attached to trolley 60. A servo-controlled motor 68 rotates the upper sheave 62 thereby moving belt 64 and trolley 60 attached thereto. A counterweight 70, which is sized to the weight of trolley 60 plus half of the anticipated load, is attached to belt 64 opposite trolley 60 in order to reduce the amount of torque required from motor 68.

Extendable support member 54 includes a container lift member 72 which is extendable along tracks 74 and a stripper 76 which is selectively movable with respect to lift member 72 along tracks 85 (Figs. 10 and 11). Lift member 72 includes a car 78 which rides horizontally along tracks 74 and a set of fingers 80 which are adapted to engaging containers in a manner that will be set forth in more detail below. Stripper 76 includes an abutment 82 and a car 84 which rides along tracks 85 independently of lift

member 72. First and second motors 86 control the respective movement of cars 78 and 84 in order to selectively extend and retract lift member 72 and stripper 76. In particular, lift member 72 and stripper 76 extend and retract together in order to lift one or more containers from a spur 44 and to deposit the container or containers on the associated cart 52. Alternatively, stripper 76 may remain stationary while lift member 72 extends. Once the container, or containers, has been deposited on the cart, stripper 76 remains stationary while lift member 72 retracts in order to prevent the container or containers from retracting with the lift member. In the illustrated embodiment, motors 86 are variable frequency motors in order to provide precise control over acceleration of lift member 72 and stripper 76. Preferably, motors 86 are controlled in such a manner in order to provide a constant acceleration during a first half of the travel and a constant deceleration during a second half of the travel of the members.

As illustrated in Fig. 13, each transport mechanism has a docking station 100 associated therewith. Docking station 100 has grooves (not shown) to accommodate wheels of carts 52 and is movable in the direction of arrow 104 to allow a cart to be wheeled on and off the docking station. Docking station 100 further includes an alignment device 102 positioned adjacent the cart in order to align packages being inserted in the cart. In the illustrated embodiment, alignment device 102 is funnel shaped.

Each spur 44 is made up of a frame and a series of rollers 90 which may be gravity rollers or powered rollers (Figs. 17a-17c). A series of slots 92 are formed in frame 88 between rollers 90. Fingers 80 are configured to pass through slots 92 of the spur 44 as the lift member 72 extends and elevates in order to retrieve containers from the associated spur 44. This configuration allows the dispatch system to handle various sizes of containers. Fig. 17a illustrates the dispatch system handling a tray 94a having sloped sides. Fig. 17b illustrates the dispatch system handling a tray 94b having straight sides. Fig. 17c illustrates the dispatch system handling a tub 94c which is significantly larger than trays 94a and 94b. As illustrated in Fig. 14, trays 94a and 94b are arranged on carts 52 in single file with three columns of four trays each. In contrast, Fig. 15 illustrates that tubs 94c are arranged in double file depth with two columns of two-high each. Dispatch system 20 can handle interchangeably both trays and tubs as follows.

When trays 94a, 94b are being dispatched, the associated diverter diverts trays onto a spur 44 until a particular number of trays, such as three trays, are diverted. At that time, lift member 72 retrieves the three trays and vertical lift 56 lowers the lift member to the appropriate height with respect to the cart 52. The lift member is extended along with the stripper above the previously deposited trays as illustrated in the left view of Fig. 7, and the lift member is retracted while the stripper is maintained in its extended position in order to deposit the trays.

In contrast, when tubs 94c are being handled by dispatch system 20, a diverter 42 diverts tubs to the appropriate spur 44 until a particular number of tubs, such as two tubs, have been diverted to that spur. At that time, lift member 72 is extended and the two tubs are lifted onto the lift member and the lift member is retracted from the spur. However, the vertical lift does not move the extendable support member at that time. After the divert 42 has diverted two more tubs to spur 44, the lift member is, again, extended and the remaining two tubs are loaded onto the lift member along with the previously two loaded tubs. At this time, the vertical lift lowers the extendable support member to the appropriate elevation with respect to cart 52 and the entire four tubs are loaded onto the cart in the manner previously described.

This cycle of diverting trays or tubs onto spurs and transporting the containers between each of the spurs and the associated cart continues until a particular cart is full. At that time, the transport mechanism associated with that cart is mechanically electrically locked out from operation and thereby inhibited from further movement. As illustrated in Figs. 12 and 13, each cart area including transport mechanism 50 is surrounded with a fence 96 having a movable gate 98. When a cart 52 is full, gate 98 is opened and the cart is withdrawn and an empty cart inserted in its place. Once gate 98 is, again, closed, the associated transfer mechanism 50 is enabled for operation. An advantage of this arrangement is that only one transport mechanism 50 needs to be locked out when a cart is full with the remaining transport mechanisms and spurs operational to sort and transport containers. This greatly increases throughput because it is not necessary to shut down the entire dispatch subsystem every time a cart is full.

Thus, it is seen that the invention provides a unique dispatch system for use with a mail processing and distribution center which dispatches sorted containers of letters which

are randomly presented to the dispatch system to appropriate carts for dispatching to individual post offices or other USPS facilities. By separating the sorting and transporting functions, a dispatch system according to the invention allows each function to take place at its necessary pace without interfering with the pace of the other function. Furthermore, the transportation function can be subdivided into as many transportation units as necessary in order to balance with the load of the sortation function. Additionally, this allows the system to continue operating at virtually full capacity even when one or more full carts are being exchanged with empty carts. Furthermore, the invention can be carried out in a relatively low ceiling height. Advantageously, a dispatch system, according to the invention, can handle numerous sizes and shapes of containers as well as containers which are sleeved and unsleeved. This greatly increases the versatility of the system.

Various altematives are possible. For example, rather than vertically transporting containers from the spur to a subjacent cart, it is within the scope of the invention to elevate the cart with respect to the spur and transfer containers directly from the spur to the cart. While such configuration may reduce cycle time, it results in an overall increase in the height of the system. This embodiment may be desirable where ceiling ~~heiglit is not a significant factor.~~

In another alternative embodiment illustrated in Fig. 18, a dispatch system 20' includes a sortation line 36' which is illustrated as a unidirectional divert but also could be a bidirectional divert. Sortation line 36' includes a plurality of diverters 42' each associated with a spur 44'. Diverter 42' both diverts containers off from sortation line 36' and transports containers at a right angle from the initial divert onto spur 44'. In this embodiment, a plurality of transport mechanisms 50' are provided, but each transport mechanism 50' is movable between a given plurality of spurs 44'. Thus, when a particular spur is full, the transport mechanism 50' moves to that spur, transports the row of containers to the subjacent cart (not shown), and inserts the containers onto the cart. The transport mechanism 50' is then free to move to another spur to transfer its load. In dispatch system 20', it would be necessary to disable the transport mechanism 50' when any one of the multiple carts being serviced thereby is full. Therefore, dispatch system 20' may have a somewhat reduced throughput, but at a cost savings.

Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention, which is intended to be limited only by the scope of the appended claims.

List of reference numbers

1	dispatch system
2	gantry robot
3	accumulation conveyor
4	cart
5	dispatch system
6	pedestal robot
7	cart
8	discharge conveyor
20, 20'	dispatch system
22	dispatch subsystem
24	merge area
26	sortation subsystem
28	manual dispatch area
30	manual predispatching operation
32	input conveyor
34a	incline belt conveyor
34b	turn conveyor
34c	incline belt conveyor
34d	"no read " discharge chute
36, 36'	sortation line
38a	scaner
38b	scanner
40	diverter
42, 42'	diverter
44, 44'	spurs
46	semicircular end section
50, 50'	transport mechanism
52	cart
54	extendable support member
56	vertical lift
58	beams
60	trolley

62	sheaves
64	belt
66	ends of 64
68	servo-controlled motor
70	counterweight
72	container lift member
74	track
76	stripper
78	car
80	finger
84	car
85	track
86	motor
90	rollers
92	slot
94a	tray
94b	tray
94c	tub
96	fence
98	movable gate
100	docking station
102	alignment device
104	direction of movement of 100